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WATERS WITHOUT BORDERS:

Scarcity and the Future of State Interactions over Shared Water Resources

By

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ABSTRACT

In response to demographic forces, climate change, globalization, shifting societal values and norms, low rates of adoption of technological innovation, inadequate domestic and international laws, and market forces, pressures on water resources have increased to levels unprecedented in human history. Unanswered, the trend will accelerate in the future.

Despite earlier perceptions that water scarcity most often leads to conflict, many recent studies conclude that cooperation is actually a more prevalent outcome in situations where two or more countries share water resources. Either way, future trends should not be overly predicated on past outcomes given that the anticipated scale of the impending water crisis exponentially outstrips scarcity conditions experienced to date.

This paper explores possible future outcomes of interaction over shared international water resources based on two driving forces—governance and technology. Strengthened national and international governance can overcome geopolitical tendencies that would otherwise discourage cooperation. High levels of technological innovation, transfer, and adoption that increase water-use efficiency or available supply reduce immediate pressures and buy time for enduring cooperative mechanisms for governing shared water resources to develop.

While universal cooperation over shared water resources is the obvious ultimate goal, the most immediate concern for the US is to prevent armed conflicts and widespread social upheaval in regions with overlapping US national interests. An understanding of what creates shared water resource “flashpoints” and the conditions that favor conflagration into larger regional conflicts is a valuable policy planning tool.

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SECTION I – INTRODUCTION

Water, like religion and ideology, has the power to move millions of people...[P]eople have moved to settle close to water. People move when there is too little of it. People move when there is too much of it...People write and sing and dance and dream about it. People fight over it. And all people, everywhere and every day, need it.

–Mikhail Gorbachev, 2000¹

The need for rules of justice is not universal. Such rules arise only under conditions of relative scarcity, where property must be regulated to preserve order in society.

–David Hume, 1748²

If the 1990s can be considered “the age of abundance” with booming capital markets, rising incomes, and politics centered on values (abortion, guns, human rights), signs indicate that the 2010s will be an age of scarcity as populations deal with impending water and food shortages, demographic change and state failure.³ Accordingly, the political agenda of states must shift to focus on providing for the basic needs of its citizens. The challenge for government is to find innovative ways to ease competitive pressures over scarce resources that lead to popular dissatisfaction with government, social and political instability, migration, conflict, violence, and perhaps even war. In the face of scarcity, states must begin by looking within, addressing supply and demand through internal initiatives. But as tempting as it seems, not all problems can be solved through single-minded dedication to the long-standing ideals of self-sufficiency and absolute national sovereignty—bilateral, regional, and even global cooperation will be necessary. Water scarcity—fresh water scarcity to be exact—is one such problem, and it is driving us towards a tipping point in human history in which large-scale future dislocations and crises are increasingly likely unless significant action is taken now.⁴ Throughout this paper, the term “water” is meant to refer to fresh water that is used in the maintenance of a food supply and productive environment for the human population, other species, and ecological processes.

Water, although often treated like a commodity, is irreplaceable—it has value not only because it underpins economic activities and human prosperity, but also because it is required to sustain life and environmental health. There is no conceivable substitute for water as there is for, say, oil or timber. The UN has declared access to water for basic human needs as a fundamental human *right*.⁵

Water is also a strategic resource in the sense that interactions over water influence political and geopolitical stability.⁶ Anywhere two or more people depend on the same source of water to meet their needs (physical, cultural, ecological, social, religious, etc.), some sort of sharing must take place. Anywhere the sharing of a scarce resource occurs, perceptions of inequality and concern for security become prime behavioral motivators. At the risk of oversimplifying, potential human responses to alleviate unpredictable access to a scarce resource fall into two general categories: competitive, zero-sum interactions in which conflict is inevitable (to the victor go the spoils) or positive sum, cooperative interactions whereby unpredictability is managed collectively (the proverbial win-win solution). These behavioral options apply to all scales of interaction over shared water resources—local, national, and international.

Worldwide, disputes over shared water resources are prevalent. Sometimes conflict results in violent clashes. More often it is resolved peacefully. There is some indication that the very nature of water as indispensable to all aspects of life makes cooperation in the face of scarcity more likely than violent conflict. From a US perspective, identifying any such trends and the factors that account for them is desirable in order to shape interactions over water in the broader context of achieving national interests.

Alarmingly, there is not yet a sense of urgency concerning a deepening global water crisis. Water has not captured the public conscience or major political agendas in the way that

climate change and energy have. There is no Kyoto Protocol equivalent for water, and the world appears unmotivated to act on the water crises that are with us today and which will only become more prevalent in the near to mid-term.⁷

At present, the ability of governments and the international community to alleviate the factors that invite conflict over water resources is tenuous in light of the lack of progress made toward reductions in CO2 emissions—a similar global scale, multi-sectoral challenge. There is room—and a need—for improvement. Political will is critical. Although there are hints of water-consciousness in recent US policy and strategy documents, they often only circuitously address the need for improved water management and governance at all levels. It is in the spirit of raising the level of attention to these ends that this paper is written.

Research Focus

Many studies undertaken in the last decade have statistically attempted to determine whether conflict or cooperation has dominated interactions between states over shared fresh water resources, some going as far back as Biblical times. These were accomplished through the lens of history, and all conclusions were necessarily predicated on the conditions contributing to water stress that prevailed at the time—demographic, ecological, economic, political, and social. While such research is invaluable in informing our understanding of complex interaction processes with regard to fresh water, it cannot be used as a stand-alone source of predicting the nature of future interactions, primarily because the conditions governing fresh water supply and demand are changing, and will continue to change *drastically* in both the near and long term.

The aim of this research paper is to carry the results of historically grounded research efforts *into the future*, adjusting for expected political, socioeconomic, and environmental changes. Will conflict or cooperation over shared fresh water resources prevail at national and

international levels? What conditions contribute to preventing conflict or at least to defusing the potential for *violent* conflict? Most importantly, how can the US apply this insight to foreign policy—what is the threat to national interests, and should more importance be placed on water as a strategic resource and as tool to accomplish other policy goals?

This paper's focus is on water's potential to drive conflict and cooperation between states. Any policy and strategy analysis is intended only as a top level planning tool. The research's usefulness lies in how convincingly it highlights the positives and negatives associated with probable outcomes of both business-as-usual and alternative policy approaches to managing shared international water resources (in terms of social, economic, and political stability).

Methodology

This research uses a scenario-based planning methodology to illustrate what the future might look like. The process is largely creative in nature although it is constrained to plausible outcomes by grounding initial conditions in facts and by tempering extrapolations with realistic assumptions. This methodology is adopted from the process described by the Global Business Network in their publication *What If? The Art of Scenario Thinking for Nonprofits*.⁸

The research begins with a literature review to provide background information on water resources, the nature of the emerging water crisis, and the history of state interactions over shared water resources (conflictive and cooperative). Second, insight into current and future trends are applied to findings from the literature review to analyze the applicability of the past to the future. From this, two factors that significantly affect the interaction between nations over shared water resources are derived. These factors become the axes for developing a matrix of possible future scenarios. There are four possible combinations of the “high” and “low” values for each factor (high/high, high/low, low/high, and low/low), resulting in four scenarios. Each

scenario is developed by creatively applying the logical effects of the high or low factor values to a situation involving shared water resources and describing the resultant “future” in a manner that is easy for the reader to visualize. Finally, the research uses the scenarios to better understand how US interests might be impacted, to identify challenges, and to identify the role that policy may play in helping to shape the “desired” future.

SECTION II – BACKGROUND

Water promises to be to the 21st century what oil was to the 20th century: the precious commodity that determines the wealth of nations.

—Fortune Magazine, 15 May 2000⁹

To appreciate the significance of interactions over shared water, it is important to understand the nature of the resource and its current status in terms of supply and demand. This section will provide a general overview of the factors contributing to water scarcity. More specific to the focus of the paper, it will then preview challenges associated with sharing water resources that cross international boundaries.

The Water Scarcity Challenge

Only about 2.5% of the earth’s water is fresh water, stored in rivers, lakes, reservoirs, glaciers, permanent snow, groundwater aquifers, and the atmosphere.¹⁰ This water is by nature a renewable resource, but it is finite in the amount available per unit of time in any one region.¹¹ Moreover, fresh water is distributed unevenly across the world’s surface. This creates problems of access to water that are compounded by spatial patterns of human settlement. Approximately 85% of the world’s population resides in the drier half of the earth, with more than 1 billion people living in arid and semi-arid parts of the world having access to little or no renewable water resources.¹² Additionally, coastal, urban areas have high population densities creating disproportionate stress on finite water resources.

This uneven distribution creates serious difficulties in fairly allocating the world's freshwater resources between and within countries.¹³ There is significant media attention given to intra-state water sharing issues. One example is the disputes between urban, ecological, and agricultural uses of water in the semi-arid Western US (pitting endangered salmon vs. irrigation dependent farmers vs. burgeoning cities). Another involves plans for an immense water transfer scheme in China (from the water-rich, industrial south to the drought-prone, agricultural north). Newsworthy inter-state water sharing issues also abound. Examples include disputes between Turkey, Syria, and Iraq over the Tigris-Euphrates Rivers, between the newly formed countries in the Aral Sea Basin following the break-up of the Soviet Union over the Naryn/Syr Darya River, and between China, India, and Bangladesh over a proposed dam on the Brahmaputra River.

Trends in population growth, urbanization, increasing per capita consumption (associated with globalization and economic development), pollution, and climate change will exacerbate existing pressures on water resources. In fact, the emerging water “crisis” is inseparably entwined with other global crises—climate change, food supplies and prices, energy, and troubled financial markets. These trends are discussed in turn below.

Population and Urbanization: Water withdrawals have tripled over the last 50 years.¹⁴ An estimated 90% of the 3 billion people who are expected to be added to the population by 2050 will be in developing countries, many in regions where the current population does not have sustainable access to safe drinking water and adequate sanitation. Urban populations in Africa and Asia are expected to double by 2030, with urban populations worldwide constituting 60% of the world's total population.¹⁵ Fully one-half of all countries worldwide can expect to face some level of fresh-water stress (defined as less than 1700 m³ of available water per capita) or scarcity (less than 1000 m³) within the next two decades.¹⁶ Some 700 million people are living under

conditions of water scarcity today, while trends promise to increase that number to three billion by 2025.¹⁷ In all, 47% of the world population will be living in areas of water stress by 2030.¹⁸

Climate Change: Water is the principal medium through which climate change will affect economic, social, and environmental conditions.¹⁹ Climate change portends increased frequency of damaging intensive rainfall events, prolonged droughts, and saltwater intrusion into coastal ground freshwater sources, among other effects. Consequently, water scarcity brought about by climate change could drive patterns of human migration, potentially plaguing water management regimes already adapted to water stress in a ripple-effect.

Food Supply, Rising Standards of Living, and Pollution: Water is fundamental to ensuring an adequate food supply. Agricultural irrigation accounts for 70% of fresh water withdrawals worldwide, producing 40% of global food on only 20% of the cultivated land.²⁰ Rain-fed agricultural systems account for the rest. Given the trend towards variable precipitation patterns in the context of climate change, increased demand for food will likely require an even greater reliance on irrigation, with the most conservative estimates calling for a 13% increase in agricultural water withdrawals by 2050, with up to a 40% increase likely.²¹ Moreover, increased demand for meat products as developing countries raise their standards of living adds pressure to water resources since meat production requires eight to ten times more water than cereal production.²² On top of this all, increased irrigation intensity threatens to reduce agricultural productivity over time as soil salinization and water logging degrade the quality of cultivated land.²³ Agricultural run-off is also a major source of pollution reducing the quality and availability of drinking water.

Energy: Water is also needed for the production of energy of all types. According the International Energy Agency, the world will need almost 60% more energy in 2030 than in

2000.²⁴ Alternative energy initiatives such as biofuels and thermal solar are also highly water dependent.²⁵

Financial Crisis: Overshadowing attempts to find a solution to the water crisis is the global financial crisis. Bilateral and multilateral aid donors are a crucial source of funding for water infrastructure in developing countries.²⁶ Not only does water infrastructure deteriorate over time without maintenance (silted-in reservoirs, leaking pipes, etc.), but reduced investment in water resources also precludes the incorporation of technological advances (irrigation efficiency, desalination capabilities, etc.) that will be necessary to adapt to water stress in the face of increased demand.²⁷

Prices and Subsidies: Moreover, the policies and market mechanisms currently adopted by a majority of governments encourage inefficient (and sometimes outright wasteful) use of water, mainly through subsidies. In the Western US, for example, water is provided below cost to farmers who opt to use flood irrigation techniques to grow water-intensive crops instead of investing in more efficient drip-irrigation methods or altering the type of crops planted.²⁸ Also, artificially cheap electricity in India has encouraged widespread and unsustainable groundwater pumping (referred to as water “mining”) for irrigation.²⁹ However, if such subsidies are reduced in order to correct price signals, allow for the proper valuation of water, and make conservation strategies more attractive, the livelihoods of many small holding farmers could be threatened.

The combined effects of these political and socioeconomic factors create an exaggerated demand for water that is out of proportion with supply. This widespread mismatch between supply and demand portends conflict over tradeoffs among domestic, agricultural, urban, and ecological uses of water at local, national, and international levels. It is how effectively this

nexus of interests is negotiated within and between governments and institutions that channels potential conflict towards violent, win-lose, or peaceful, win-win resolutions.

The Challenges of International Shared Water Resources

As of 2004, there were 263 transboundary river basins sharing water resources worldwide.³⁰ Over 40% of the world's population lives in these basins—over 90% of the water resources of the Middle East crosses an international border, and Africa alone contains 60 international rivers.³¹ At least 20 countries are dependent on rivers that cross national boundaries for more than half of their total water supply, with 14 countries obtaining at least 70% from rivers outside their sovereign borders.³² For example, Egypt obtains 97% of its freshwater from the Nile, but due to its location at the river's terminus, it is the last of 10 Nile-sharing countries to receive its water allocation. In the Middle East, *all* of the major rivers cross international boundaries.³³ Ominously, the region is experiencing some of the highest population growth rates in the world (some have doubled in last 20-25 years), and has exceedingly low amounts of per capita water availability to begin with.³⁴

In many areas of the world transboundary water resources are shared but not managed jointly, and there are no commonly acknowledged principles to guide partners as to how much each of them use of the common pool and for what purposes. The outcome is disastrous as water resources worldwide are over-utilized and heavily polluted.³⁵ Most rules of international water law derive from treaties or international custom.³⁶ But both methods suffer from consensus, performance and enforcement challenges.

Treaties, though they provide a somewhat tangible commitment to cooperative sharing of a water resource than a relationship based on international custom, are often paper tigers. For example, compliance with an international agreement between the four countries in the

Naryn/Syr Darya River basin in Central Asia has been high, but the performance of the agreement over time in terms of solving concrete water problems between the nations has been very low and highly variable.³⁷ Treaty commitments are often defined so that meeting them requires little effort above and beyond what states concerned would do in the absence of international commitment.³⁸ Further, the establishment of treaties often takes decades to achieve while resource continues to be further degraded.³⁹ Finally, the majority of treaties established are bilateral in nature, often excluding other riparian members whose participation is necessary for effective joint management.⁴⁰ For example, the often praised Mekong River Commission in Southeast Asia excludes the upstream riparians China and Myanmar. Their actions can influence water resources that lower riparians depend on despite their efforts to benefit by cooperation.

In the absence of treaties, international water law based on custom is the only legitimate tool for achieving some level of cooperative behavior. However, behavioral norms are difficult to establish, interpret, and enforce across cultures and borders. International custom must balance countries who differentially subscribe to doctrines of absolute territorial sovereignty (e.g. upstream riparian powers such as China or Turkey who maintain that it is their right to use the waters flowing through their territory in whatever manner and quantity they choose) or absolute riverian integrity (e.g. downstream riparians who maintain that a state may not alter the natural flow of waters passing through its territory in any manner which will affect the water in another state).⁴¹ As customs evolved over time, the intermediate idea of limited territorial sovereignty has in recent decades been deemed the most appropriate foundation for international water law, and its principles underpin recent attempts to codify norms in the 1997 UN Watercourses Convention and the 2004 Berlin Rules.⁴² These international norms for the use of transboundary fresh water resources reflect the principles of: 1) the duty to cooperate and

negotiate in good faith with the genuine intention of reaching an agreement; 2) the obligation to prevent harm to other states; 3) the duty of prior consultation; and 4) the principle of equitable utilization whereby the interests of all riparian countries are taken into account when allocating and using international watercourses).⁴³

As noted, not all countries accept these principles as “norms” equally, which makes true “joint” development of international waters difficult to achieve due to disagreements over sovereignty, ownership of waterworks, jurisdiction, financing, scope of cooperation, etc. Further, most customary water law applies only to surface water, not transboundary aquifers or groundwater.⁴⁴ And despite convergence towards a more widely accepted body of international water law, only 16 countries had ratified the 1997 UN Convention as of 2008.⁴⁵

Given the tentative nature of international water law, whether treaty or custom based, agreements have tended to address only selective aspects of water planning or to create organizations that have a coordinating rather than a joint planning or management role.⁴⁶ This makes them susceptible to future systemic or political changes.

SECTION III – LITERATURE REVIEW

Whiskey is for drinking. Water is for fighting over.
–Mark Twain⁴⁷

The wars of the next century will be about fresh water.
–Ismail Serageldin, former World Bank Vice President⁴⁸

The previous section highlighted the abundance and intensity of stresses currently affecting shared water resources. The potential for conflict is palpable, but are predictions that in the future humanity will witness widespread, water-induced violence and war founded? A review of the literature reveals two major periods of thought. In the last decades of the 20th century, it was common to hypothesize about competition for fresh water becoming an

increasingly prevalent source of conflict and war. This was followed by a more recent period of challenge in which several quantitative analyses were undertaken in the mid 2000s, with results seeming to refute or at least ameliorate earlier suppositions.

This section analyzes the validity of both claims from a historical perspective. First, the case for predicted conflict is outlined, showing how water-related conflict is theorized to arise between states. Second, the opposing view—the case for predicted cooperation—is discussed. Third, empirical data is presented that sheds light on the overall historical nature of interactions over shared water resources, and whether any specific indicators can be linked to either conflict or cooperation. Fourth, a holistic picture of evidence for the conflict vs. cooperation debate is synthesized, suggesting that the prevalence of one or the other depends more on a conglomeration of contextual factors than on water scarcity or its effects alone. This leads to the fifth section—how institutional capacity encompasses many of the contextual factors that drive conflict or cooperation in the face of water scarcity. Finally, armed with a proper historical perspective and the preference for cooperation over conflict, a tentative way forward is indicated based on the shortcomings of current arrangements.

The Case for Conflict: Water-Related Causes

Water-related tensions can emerge both between and within states on four interdependent levels: local (e.g. over access to a water point or over privatization of drinking water); national (e.g. between sectors—farmers, fisheries, environmentalists, power companies, etc); international (e.g. between upstream and downstream states over the use of shared rivers); and global (e.g. between food exporters and food importers in relation to the world food market through concept of “virtual water”).⁴⁹ As indicated, the focus of this research is on international conflict, but conflict at all levels has important implications for strategy as discussed later.

The theory that water scarcity drives conflict (and the notion that it will accelerate in the future) is based on the realist perspective of international relations in terms of environmental threats to security. Realists acknowledge a state-centered, anarchic world order that emphasizes self-help, and drives a zero-sum, competitive mindset wherever strategic resources such as water are at stake.⁵⁰ The cost of cooperation, in realist eyes, is a loss in national sovereignty that comes with negotiated solutions and subjection to international institutions and mechanisms. It boils down to managing uncertainty—they argue that states are loathe to enter into binding contracts while there is no widely acknowledged and agreed upon international water law or reliable enforcement mechanisms and arrangements (see Section I above).

Water can be either a direct or indirect source of conflict. In the international sense, water as a direct source of conflict involves strategic rivalries and power politics as states interact over access to—or inequality in the use of—shared water resources where water is a source of economic or political strength.⁵¹ Examples abound in the Middle East. Although it is not attributed as *the* primary cause of hostilities, one factor precipitating the 1967 war was the attempt by Arab states to divert the Jordan River away from Israel. Israel's response was based on the mindset that "water is a question of life for Israel," and therefore it would "act to ensure that the waters continue to flow."⁵² Another example is Egypt's downstream position on the Nile River and the idea that, as a regional power, it would go to war over water given its vulnerability to flow reductions stemming from the actions of upstream nations. Egypt's foreign minister in the 1980s said that "the next war in our region will be over the waters of the Nile, not politics," while President Anwar Sadat said in 1979 that "the only matter that could take Egypt to war again is water."⁵³ In this era of literature, many authors viewed the growing pressures on already strained water resources as evidence for an increase in the probability of armed conflict.

An extension of the power politics argument involves using water as an instrument for achieving other goals in the context of a broader dispute. Despite the fact that conflict exists for some other reason, scarcity arguably increases the effectiveness of water as a political instrument: “As water supplies and delivery systems become increasingly valuable in water-scarce regions, their value as military targets also increases.”⁵⁴ As an example, consider the Southeastern Anatolia Project (GAP) in Turkey. In the 1990s, Turkey threatened to reduce the flow of the Euphrates to Syria and Iraq in order to force them to withdraw support for Kurdish rebels operating in Turkey. Syria and Iraq are both dependent on the river—a planned dam on the Tigris could deprive Mosul in Iraq of 50 percent of its summer water requirements.⁵⁵ Tensions continue today. Despite an agreement to increase flows to Iraq (which is suffering from a bad drought in 2009) for a one year period, Turkey is not willing to enter into any long-term agreement. Turkey’s position is that “Turkey wants to use all its advantages,” since negotiation is not working, and the possibility of solving the problem is not very high in light of ongoing conflict with the Kurds and harsh press announcements by Iraq.⁵⁶ A realist would argue that these stresses increase the potential for Syria or Iraq (or separatist groups like the Kurdish PKK) to target water infrastructure in Turkey.

In the same manner, it is theorized that conflict can also take the form of disputes between water-rich and water-poor nations if one nation reaches an absolute limit on industrial development due to water constraints.⁵⁷ Moreover, inequalities in the level and quality of water can result more from the insufficient capital, technology, know-how, and governmental institutions that are prevalent in developing nations rather than from a physical lack of water. These resource gaps can lead to increased poverty, shortened lives, and misery that results in either internal violence or an increased likelihood of international disputes through the indirect

effects of cross-border refugees that take their toll on the political, economic, and military capacities of neighboring states.⁵⁸

A final source of potential conflict is major water developments that displace large populations, adversely impact downstream users, or alter the equilibrium of economic benefits derived from the resource.⁵⁹ As with the preceding example, this could lead to disputes among ethnic or economic groups, between urban and rural populations, or even between states.

These realist-oriented security concerns become more immediate as countries press against the limits of available water in the face of scarcity, leading one set of authors to conclude in 2001 that “more than 50 countries on five continents might soon be spiraling toward water disputes.”⁶⁰ Similarly, the United Nations estimates that 300 potential conflicts over water exist around the world today.⁶¹ Such conclusions were common in the last decades of the 20th century.⁶² Authors advocating the potential of water scarcity to incite conflict insist that even though the last outright water “war” between two nations (actually two Mesopotamian city-states) was 4,500 years ago,⁶³ the past will not be a reliable guide for the future. For them, the increasing pressure being levied on already thin water resources is the decisive factor, and it overshadows any cooperative tendencies that may have previously surrounded interaction over shared water resources. Given the pressures created by population growth, urbanization, pollution, and climate change, one author argues that competition for water will intensify, conditions are likely to deteriorate, and “at some point the balance between cooperation and conflict will tip in the direction of the latter.”⁶⁴ Another stresses intra-state conflict: “We should be concerned not only with outright water wars, but with humanitarian crises and civil unrest, both of which will increase as water scarcity spreads. We are likely to see more climate and

ecological refugees. All of this will be very destabilizing unless the global community prepares for it.”⁶⁵

The legacy of all of this is that the case for conflict has been widely adopted by the popular press, perhaps due to its intuitive appeal to realist reasoning—in a zero-sum, competitive system, when push comes to shove, people and states will act in their own best interest. Indeed, there has been plenty of saber-rattling—China and India, India and Pakistan, Israel and its neighbors, and Turkey and Syria/Iraq all being prominent examples. The idea’s longevity is in part based on perception. Memorable quotes (see section headers) abound that serve to propagate predictions of conflict from historical icons (Mark Twain), influential leaders (Ban Ki-moon, Ismail Seregeldin, Mikhail Gorbachev), and the popular media (Fortune magazine). Violence is a media magnet, while cooperative conflict resolution is not always considered newsworthy. People repeat what they hear as long as reasoning appears logical. But what appears logical can be deceptively unfounded.

The Case for Cooperation: Realizing Shared Interests

The argument that states tend to engage in cooperative behavior in the face of scarce, shared water resources is built on the presumption that any potential reductions in national sovereignty are outweighed by other types of benefits gained and costs avoided. Thus, those who discount the idea that increasing water scarcity will result in more conflict focus on examples where benefit sharing from cooperation offers greater rewards than could be achieved through unilateral action.⁶⁶ Quite simply, states stand to lose more and gain less from conflict than from cooperation. Cooperation is more cost-effective, efficient, and attractive because ensuring steady access to unpolluted water from shared sources depends not necessarily on acquiring and occupying territory, but rather on projects undertaken outside of national borders.⁶⁷

On its own, a nation might still lack the technical or financial resources to adequately develop water resources in newly occupied territory, and pollution from even further “upstream” could still degrade the resource. Therefore the costs of an armed conflict over a shared river often outweigh the benefits of potential victory. When asked whether water was a primary factor in Israel’s decision to invade Lebanon in 1982, an IDF analyst responded: “Why go to war over water? For the price of one week’s fighting, you could build five desalination plants.”⁶⁸

Critics of the realist perspective that violent conflict over water is going to be an increasingly salient element of interstate politics might argue that the viewpoint is based on an under-appreciation for the capacity of international institutions and national governments to alleviate uncertainty surrounding water scarcity cooperatively through treaties and laws—by looking out instead of in so as to internalize the problems, allow all stakeholders a voice in the management of the shared water resource, and to realize win-win outcomes. Communicating shared interests and shared benefits is the fuel that drives cooperation. There are many examples. In the 1957 Mekong Agreement, Thailand helped fund a hydroelectric project upstream in Laos in exchange for a proportion of the power to be generated (one of its own needs).⁶⁹ In 1986, South Africa helped Lesotho finance a hydroelectric/water diversion facility in exchange for rights to drinking water for Johannesburg.⁷⁰ In 1959, Egypt and Sudan amended an agreement over Nile that lessened Egypt’s water security concerns through the construction of the Aswan High Dam and Lake Nasser, while financially compensating Sudan and allocating it a larger proportion of flows than would be expected given Egypt’s status as a regional hegemon.⁷¹ In addition, even though the water in the Nubian Sandstone Aquifer System underneath Libya, Egypt, Chad, and Sudan is largely unregulated, there is a nascent cooperation group—a small step that can be exploited for more peaceful solutions in future.⁷²

Empirical Evidence and Indicators

While there is some evidence (and much rhetoric) for being wary of increased potential for violent conflict over shared water resources, several recent quantitative studies refute earlier suppositions.⁷³ These studies determined that: 1) cooperation has been far more prevalent than conflict throughout the history of interactions over shared water resources, and 2) that hypothesized indicators typically associated with an increased potential for conflict are not supported by historical data. We will look at each of these conclusions in turn.

History points to predominantly cooperative outcomes when nations interact over shared water resources. Research shows that over 3,600 water related treaties were signed between the years 805 and 1984.⁷⁴ More recently, it has been found that between 1948 and 1999, international relations over fresh water resources were overwhelmingly cooperative—out of 1831 water events analyzed, 67% were cooperative and 28% were conflictive.⁷⁵

What is the significance of these numbers? For one thing, it suggests that water does not necessarily follow the patterns of interaction common to other scarce “strategic” resources such as oil.⁷⁶ In general, countries exhibit greater cooperation over water than would have been predicted in the context of their overall international relations, indicating that countries in conflict for other reasons may still find common interests for cooperation with regard to shared water resources.⁷⁷ Water has always been a component of Arab-Israeli relations. Despite earlier conflictive relations over water, water resources were one of the five multilateral tracks designed into peace talks in the 1990s, and it is the only one of the five that still survives.⁷⁸ Israel, Jordan, and the Palestinians have recently agreed to study the possibility of a canal to bring desalinated water to all three countries. One author notes that “because water is tied to everything we do, water is often what gets us in the room [to talk] when nothing else will.”⁷⁹ Moreover, once

potential competitors or enemies begin to cooperate over water, they also begin to develop a shared vision of their future because water is tied to everything, which leads to further cooperation on other fronts. Similarly, the OECD has written that “a mutual need to share water may be useful to help forge peaceful cooperation between societal groups.”⁸⁰

This might explain why once cooperative agreements are in place, they tend to be surprisingly resilient despite on-going disputes between the involved parties over other matters.⁸¹ For example, the Mekong River Commission’s member nations exchanged data throughout the Vietnam War, and the Indus River Commission survived two wars between India and Pakistan.

The above numbers are also contrary to predictions that population and other pressures on shared water resources should result in more conflict. In one study, cooperative events actually increased in number in the later years of the study when water stress was intensifying and its effects should theoretically have driven more competitive, conflict-prone behavior.⁸²

Recent quantitative research also assessed the ability to link specific indicators to conflictive or cooperative tendencies. This research analyzed many of the triggers predicted to increase violent interactions over shared water resources as cited in realist, security-centered literature. But none of the studies found definitive, single-factor “calling cards” that were highly associated with conflict. In one study, linkages between conflict and such factors as spatial proximity, government type, climate, basin level water stress, dams and infrastructure development, and dependence on fresh water resources for agriculture or energy needs were unsupported by the data.⁸³ Even those that did show some level of statistically significant association with conflict had only weak positive correlations (e.g. high population densities, low per capita GDP, and overall unfriendly international relations).⁸⁴ In a similar study concerning international rivers, it was found that upstream-downstream relationships, recent militarized

conflict over other causes, and level of economic development did not significantly affect whether countries signed treaties over shared water resources or not.⁸⁵ By contrast, this study did find some indicators associated with cooperation over international water resources. Specifically, the presence of a country with a preponderant power distribution, high levels of economic interdependence, democratic governance systems, and the condition of water scarcity itself were shown to actually increase the chances for formalized cooperation.

A Holistic View

Even though history suggests that cooperation over water has been the norm (accounting for two-thirds of all interactions), it has not been the rule. One-quarter of water-related interactions over the last 50 years have been hostile, with 37 recorded occasions where shots were fired, a dam was blown up, or some other form of military action occurred.⁸⁶ Further, even though the number of cooperative water sharing outcomes has risen in recent years, as a percentage they have remained relatively constant.⁸⁷

Likewise, some statistics might indicate at first glance that there is a correlation between intensifying pressures on shared water resources and increasing conflict. Conflicts over shared water resources have increased from an average of five per year in the 1980s to 22 in the year 2000.⁸⁸ Again, though, conflict as a percentage of total water-related interactions has remained surprisingly stable at roughly 25 percent. Moreover, it must be noted that conflict in general has increased since the end of the Cold War. It is difficult to isolate environmental or resource factors (e.g. water scarcity) as the single “cause” of a conflict in the presence of numerous other intertwining factors such as religious animosities, ideological disputes, arguments over borders, and economic competition.⁸⁹

Perhaps a more interesting interpretation of the rising number of interactions over water—both cooperative and conflictive—is that water is becoming a more central issue in a state’s domestic and foreign policy considerations. This idea will be revisited in Section VI.

On balance, though, history suggests that no common wisdom indicators surrounding interactions over shared fresh water resources correlate more than weakly with conflict. So it can be safely said that cooperation or conflict depends on a more expansive set of contextual factors unique to each situation. The most useful indicators for potential water conflict should involve a confluence of socioeconomic and geopolitical factors. One recent study validates this idea, concluding that the most likely scenario for conflict over shared water involves rapid or extreme physical or institutional changes within a basin that exceeds the institutional capacity of the basin to absorb that change.⁹⁰ Such an event might be the unilateral construction of a dam on an international river (for example, if China went ahead with plans to dam the Brahmaputra River without negotiating with the downstream nations of India and Bangladesh over the effects) or the internationalization of a basin from the break-up of a larger state (for example, the tensions between newly independent countries in the Aral Sea region of the former Soviet Union). Another study found that water disputes in the spatial context of ardent democracies neighboring fervent autocracies are more conflictive than other mixes of government type.⁹¹

Overall, it may not be steady-state trends such as increasing water scarcity or population growth per se that provide relevant indicators of potential conflict or cooperation, but rather the discontinuities such as extreme climatic events or sudden institutional change.⁹² Assuming that this is indeed the case, the question then becomes how to mitigate the uncertainty associated with stochastic events that create conditions in which interactions over shared water resources hang in the balance, favoring conflict as much as cooperation despite the latter’s historic prevalence.

This idea of a state's capacity to mitigate uncertainty will be central to the selection of factors that drive interactions over shared fresh water resources, and deserves further consideration.

Institutional Capacity

It is a resounding theme in the literature that institutional capacity significantly affects cooperation. Capacity in this sense refers to the existence, strength, and provisions of institutional mechanisms (governments, water administration and management agencies, international water treaties, international organizations, etc.) at both state and basin levels that provide a means for mitigating or managing the uncertainty which theoretically drives international conflict.⁹³

The significance of institutional capacity is emphasized by numerous authors. The OECD states that “often it is not the actual lack of water that may lead to tensions but rather the way in which water is governed and administered. Violence can result where there is weak institutional and social capacity to mitigate problems...of discrimination over access to water.”⁹⁴ Anand observes that conflict arises not from resource scarcity but from “governance or state failure, weak institutions and policy-making processes, aid dependence, corruption and various historical and geographic factors that can worsen inequality in societies.”⁹⁵ UN Secretary-General Ban Ki-moon argues that water stress will impact peace and security in politically-charged, vulnerable regions where weak state institutions lose control over the forces of law and order, lose political legitimacy, and are unable to deal with multiple stresses at the same.⁹⁶ Yoffe et al. indicate that the quality of governance within a water-stressed basin may hamper a government's ability to cope with change.⁹⁷ Tir and Ackerman note that less developed countries “typically lack mature political institutions that are helpful in overcoming the impasse to reach regulatory treaties.”⁹⁸ Dinar, too, posits that cooperation depends on institutional

arrangements among states that increase transparency, lower transaction costs, prescribe behavioral roles, shape expectations, and ensure compliance through issue linkage, reciprocity, and side payments.⁹⁹ Nicol echoes these thoughts: “Violence over water is most likely where other intervening factors are particularly strong...state failure (as in Darfur) [and] weak governance.”¹⁰⁰ Finally, Turton adds: “Water scarcity has a tendency to magnify existing tensions...and is often accompanied by poverty, low levels of health and education, and consequently fewer opportunities to get a better share of the overall wealth of society. When the level of expectation by society exceeds the capacity of government to deliver, then violence can be an outcome.”¹⁰¹

International institutional capacity can be as important as that of individual states. In conjunction with their observation that less developed countries typically lack mature political institutions, Tir and Ackerman submit that active involvement by the developed world and IGOs will be required to foster political development and create the realization that environmental security concerns are interlinked with other countries in a basin.¹⁰² Likewise, Dinar cautions that cooperation may have to be encouraged by outside agents such as international institutions or regional powers when scarcity is very high, especially in Africa.¹⁰³

This evidence shows that the relative strength of its institutional mechanisms determines a country’s ability to understand and respond to stresses upon water resource systems. Strong institutional capacity effectively “absorbs” uncertainties over variability in water supply and demand that would otherwise push states into a reactive strategy in which short-term needs drive competitive, conflict-prone interactions. It extends planning horizons and shifts the focus of all stakeholders to a more proactive and cost-effective long-term strategy that favors cross-border collaboration.

The Way Forward

The literature review shows that water, for whatever reason, has tended to induce cooperative interaction outcomes between nations. But there will always be *some* degree of conflict over shared fresh water resources ranging in intensity from minor disagreement to serious tension, open dispute, and even armed conflict. Realist security concerns in the face of increasing water scarcity are real, even if resolution by violent conflict is perhaps less likely than previously speculated. But whether or not water scarcity has caused outright war between nations, or that it will increase in potential to do so in the future, is in some ways irrelevant. There is no disagreement that water-related tensions *already* cause enough violence and conflict within nations to threaten social and political stability.¹⁰⁴ The past five years have witnessed violent clashes resulting in human deaths between farmers in northern China and state police over decreased access to irrigation water from a planned dam; between pastoralist tribes in Kenya and state police over access to water for livestock that have at times spread across the border with Ethiopia; and between farmers and irrigation council officials in a district of India bordering Pakistan—there are many other examples.¹⁰⁵ It is also easy to forget that the civil war in Sudan and the crisis in Darfur were largely over access to fresh water. Recent history has proven that civil conflicts of any nature that go unresolved can spill over borders and provoke international violence (e.g. the Balkans or Rwanda). Even if they eventually give way to cooperation, such occurrences can fuel decades of regional tension, economic stagnation, and the constant threat of escalation into larger conflicts.¹⁰⁶

Moreover, despite the top-billing that the cooperative nature of interaction over shared water resources has recently enjoyed, there are reasons to be concerned about the robustness of many existing cooperative agreements as they intersect with the effects of current and future

trends that negatively impact fresh water supply and demand. One reason for concern involves the limited extent of existing cooperative arrangements over shared water resources. As of 2003, only 117 of the world's 263 international basins had treaties managing the use of shared fresh water resources.¹⁰⁷ In the Middle East, the groundwater that Israel relies on is recharged by rainwater coming from Lebanon, Syria, the West Bank, the Golan Heights, etc. One author thinks that whether the groundwater reserves of Middle East will be a source of conflict or peace depends on how the states develop their diplomatic and economic relations on these issues, but they are "far from putting pen to paper on even the simplest of underground water treaties."¹⁰⁸

A second reason is that some research has begun to reveal that existing agreements are often only paper tigers—the results of studies that emphasize the role of cooperation must be qualified since they focus primarily on political commitments or compliance with international agreements rather than on performance of the actual agreement over time, which can be low or highly variable.¹⁰⁹ The fact that more cooperation than conflict over water has occurred says little about whether international cooperation *performs* well in terms of problem solving. If basic supply and demand problems aren't satisfactorily addressed, then the potential for conflict remains high as future stresses on the resource (such as fluctuating availability) change basin water dynamics. For instance, Iraq, Qatar, Bahrain, Kuwait, and Jordan have established a Water Cooperation Committee to discuss the establishment of drinking water pipeline grids and other regional infrastructure networks, but full-fledged cooperative efforts have been spotty at best.¹¹⁰

A third reason involves time constraints. Dinar has argued that cooperation is most likely in cases of moderate scarcity.¹¹¹ He argues that cooperation is superfluous in cases of resource abundance, and it breaks down in cases where there is already an acute, debilitating scarcity. This suggests a time limit for taking action prior to resource conditions deteriorating beyond a

certain threshold. Combined with the fact that cooperation in the past often evolved only after years of instability and conflict (and sometimes even then only with the assistance of outside institutions or investments), it is easy to see the potential for disaster in the form of conflict or humanitarian crises. All of the countries in the Water Cooperation Committee discussed above already withdraw far more water than is replenished on an annual basis. This is an unsustainable practice, and it remains to be seen if the baby-steps towards cooperation over regional water resources will be sufficient as time runs out.

A final reason is that static, bilateral treaties are the norm, often rigidly governing only one or a few aspects of water management in a given basin.¹¹² Ongoing, multilateral cooperative efforts at comprehensive joint planning and management are desired so that all stakeholder interests are included, and so that any management arrangements are adaptable to changing conditions. The Mekong River Commission is often applauded for its successes to date in jointly managing shared water resources among several Southeast Asian nations (Cambodia, Laos, Thailand, and Vietnam). However, China is not a member despite its strategic upstream position. China's exclusion is of concern in light of recent patterns of international behavior that suggest it is becoming increasingly assertive in pursuing its security requirements. In the future, any unilateral development projects by China on the Mekong could negatively impact downstream nations and upset current cooperative arrangements.¹¹³

Wrap Up

If predictions that widespread cooperation will result as shared water resources become increasingly scarce turn out to be correct, great. If instead, predictions of increasing conflict are vindicated, it will only be because the status quo is maintained and no actions are taken to alleviate the effects of water scarcity. The human race is inherently suited for self-help—this is

the *raison d'être* for human social and political organizations. Evidence presented in this section suggests that predictions about conflict or cooperation over shared water resources in the future are really predictions about the capacity (or incapacity) of states and their international community benefactors to deal with uncertainty in the face of intensifying pressures. Knowing this can help create effective strategies to “shape” interactions over shared water resources, steering them away from conflict and towards long-term cooperation. The task of those with a role to play in mediating international interactions over shared water resources (governments, administrative agencies, international organizations, etc.) is to manage the conflict, to prevent escalation, and to promote mutually beneficial cooperation.¹¹⁴ The next section will assess the factors that influence state and international institutional capacity to accomplish this. It will draw on principles identified in the literature review above in combination with insight on emerging future trends.

SECTION IV – DRIVING FORCES

The vulnerability of ...populations to water stress is worsened by the state's loss of control over the forces of law and order and ultimately by its loss of political legitimacy.
–UN World Water Assessment Programme, 2008¹¹⁵

Quite simply, if these two sectors can improve the use of water, there will be more water for others. Worldwide, manufacturing wastes water and consumes large amounts of water by pollution. Agriculture uses 70 percent of the world's water. We must have the will power to look at the waste in these two areas and initiate improvement.
–Steven R. Lorranger, ITT Industries, 2005¹¹⁶

This section will derive two driving forces from the tangled web of factors that influence interactions over shared water resources. It will then define and further explain these two selected driving forces. Finally, current and future trends (e.g. globalization, free trade, the evolving nature of international institutions and emphasis on state sovereignty, public-private

partnerships, global economic health, etc.) will be discussed in terms of how they will likely impact the vector that each driving force imparts on interstate water interactions.

Choosing the Driving Forces

The forces that interact to produce water scarcity are not necessarily the same ones that drive conflict or cooperation over shared water resources *given* that scarcity. The literature review provided results from research that show how many of the ultimate causes of water scarcity are uncorrelated with the outbreak of violent conflict. Rather, of primary interest are the forces that alleviate the effects of water stress as they are experienced (to prevent competitive behavior that could result in violent conflict) or influence the ability of states to deal with scarcity peacefully. In order to select appropriate driving forces, it is necessary to somehow narrow down the host of possible influencing factors.

First, the physical forces that drive global water scarcity patterns such as climate change are not proximate drivers of conflict or cooperation. Climate change can only be indirectly combated, and even then man has relatively little control over its effects. Whatever its causes—manmade or natural variation—its effects are real and they are relatively certain to continue for at least the near to mid-term (i.e. the next few decades). In the end, how states are equipped to deal with the effects of such physical forces is of more immediate relevance.

Similarly, demographic and social changes such as population increases, increasing urbanization, globalization, or economic development and the resulting increased demand for items associated with higher standards of living are not the most immediate driving forces. These are largely social trends that man has little control over without government directed and enforced curtailment of personal liberties, which is neither politically feasible nor socially acceptable. These effects are also relatively certain to continue. Moreover, the literature review

indicated that no single-factor indicators of demographic pressures (e.g. per-capita water availability, GDP, etc.) were shown to be more than indirectly linked to the potential for conflict. The real interest is found again in how the attendant effects of these forces are dealt with by the states involved.

It is the more unpredictable factors that humans, their societies, and governments have some measure of control over that are of primary concern in our search for drivers of conflict and cooperation. These factors include shifts in the rate and intensity of water pollution, changes in water-use efficiency and conservation-oriented behavior (demand-side), infrastructure improvements or development of alternative water sources (supply-side), unforeseen technological advances and the adoption of existing technologies, and changes in institutional and governance capacities. These and other similar factors have the ability to “downgrade” the water crisis into a more manageable challenge that either falls within the capabilities of existing human institutions or “buys” more time for cooperative arrangements to develop between states.

In short, it is assumed that water scarcity will continue to increase (given the status quo), and alleviating many of its ultimate causes is either impossible or cost-prohibitive at this time. Thus, the appropriate driving forces will be selected from the pool of more proximate causes of conflict and cooperation in the face of experienced scarcity. At this level of proximate causes, there are two broad approaches to influencing the outcomes of interaction. One method attempts to directly affect how water scarcity is handled—peacefully or competitively. The second method attempts to slow the onset of the effects of water scarcity, giving the mechanisms employed by the first method more time to develop enduring solutions.

The first method is about shaping interactions—it is about governance and institutions that manage uncertainty and perceptions of inequality by providing for the needs of citizens. As

shown in the preceding section, the importance of governance and institutional capacity is extensively supported by the literature—both by those who argue that conflict will increase if the status quo persists and by those who argue that cooperation naturally arises in situations of water scarcity. The second method is about sustainability—it is about behavior, technology, and incentives that act to slow or slightly reverse the effects of increasing demands on water resources. However, economic incentives are largely policy driven and thus fall under the purview of governance (due to water’s status as both a common pool resource and a "human right" of sorts). Moreover, behavior is a social phenomenon that is difficult to target directly or effectively. So this paper’s approach to sustainability will be primarily focused on technology.

The central driving force from each of these two general methodologies will become the axes for developing this paper’s future scenarios. The two selected driving forces are: 1) quality of governance, and 2) level of technological innovation, transfer, and adoption. For clarity and simplicity they will be referred to as governance and technology. The next task is to define and explain each of these driving forces in more detail.

Explaining Water Governance as a Driving Force

Definitions for “good” governance abound. For the purposes of this paper, a suitable definition is “creating and enforcing a regulatory and fiscal framework that ensures honest expenditures of public funds and transparency in operation with public participation in decision making.”¹¹⁷ More precisely, good governance “relates to a regulatory system that shows qualities of accountability, transparency, legitimacy, public participation, justice, efficiency, the rule of law, and an absence of corruption.”¹¹⁸ With respect to transboundary water resources, then, governance occurs at multiple levels including national governments, national water

administration agencies, international organizations, treaties, international water law, and regional-level water coordination, planning, and management bodies.

Water governance currently suffers from two fundamental problems—the absence of a sufficient number of appropriate water management institutions and the chronic dysfunction of existing institutions at all levels.¹¹⁹ These institutions are often unable to serve the people they represent or to balance demands across sectors and across boundaries.¹²⁰ Many national and international water policies, laws, treaties and administrative organizations either inadvertently exacerbate the effects of water scarcity by causing an unequal distribution of benefits from water developments, fail to alleviate them by not taking advantage of known technologies or existing solutions, or attempt to apply an inappropriate solution that ignores context-specific factors.¹²¹ Frequently, inflexible water institutions are unable to adapt in step with rapidly changing water conditions.

At the international level, water governance is characterized by comparatively immature structures and processes that are slow to evolve.¹²² Many international water organizations have ambiguous and overlapping functions which degrades overall effectiveness. For example, no centralized UN agency is authorized to make policy, and the agency intended to ensure collaboration among agencies (UN Water) does not have a strong mandate. The result is low levels of consensus, ratification, and enforcement of international water law, developmental aid administered on an ad hoc basis (often not reaching the countries with the greatest need), and a marginal capacity to encourage cooperation or mediate between states engaged in shared water disputes.

To preclude conflict over transboundary water resources, water governance at all levels must possess certain attributes. In general, it should take a whole basin or regional management

approach wherever possible. Given the diversity of regional interests, it is often the case that national sovereignty must assume a subordinate role in decision making. The following principles provide a rough idea of the types of attributes associated with good water governance.

Principle 1—*The maximum number of stakeholders possible should be included in decision-making processes.* An open, participatory system engaging all relevant stakeholders across sectors and across borders allows competing interests to be “internalized” and starts dialogue towards the development of shared interests.¹²³ At the international level this leads to regional stability by alleviating security concerns. At the national level it leads to internal stability as the needs of all citizens to include the poor and minorities are met.

Principle 2—*Flexible, multilateral, joint management arrangements are better than static, bilateral, agreements that focus narrowly on water allocation or specific development projects.* Such institutions are more able to adapt to changing conditions in a measured, cooperative manner by balancing the needs of a greater number of players.¹²⁴ They dampen inclinations for one party to engage in unilateral development of a shared water resource that has been proven to invite conflictive outcomes.¹²⁵ They are more substantive (compared to the abundant paper-tiger treaties currently in effect), more enforceable (given the weight of more players), and encourage the development of a more robust international system of water law. Cooperation is more likely to emerge as the costs of “transaction” between states are lowered through the mechanisms of issue linkage, reciprocity, side payments, and expectation shaping.¹²⁶

Principle 3—*Transboundary water problems must be depoliticized in order to discourage hydro-nationalism and defuse sovereignty issues.* Many states are physically or financially unable to solve water scarcity problems on their own. The politicization of water resources and the race for self-sufficiency often results in unsustainable water use and degradation as states

turn to groundwater mining or do nothing to discourage pollution from agricultural or urban runoff. A good first step in depoliticizing water involves data exchange. Experience has shown that transboundary, scientific-community dialogues and data and information exchanges can result in a better understanding of the shared resource, the formulation of joint solutions to scarcity problems that generate benefits for all users, and an improvement in the quality, quantity, and productivity of the resource itself.¹²⁷ For whatever reason, the non-political nature of the scientific community makes recommended solutions more “acceptable” to all parties involved.

Principle 4—*International institutions and mechanisms will play a key role.* The power of IGOs is their neutrality and potential to mediate disputes and encourage cooperation. External organizations and agencies have often played an important role in the successful implementation of joint transboundary water resource management institutions by providing the necessary means (financing, expertise, etc.) for implementation.¹²⁸ Empowered IGOs can also appropriately channel limited resources based on need. In the past, the lion’s share of both private investment and official development assistance has repeatedly gone to the same few countries and largely avoided the regions of greatest need.¹²⁹ IGOs can assist in the transfer of context-appropriate water efficiency technologies. They can provide a much needed adjudication and enforcement function with the emergence and greater acceptance of a standardized international water law based on the norms of limited territorial sovereignty for both ground and surface waters (equal use, no harm, consultation, and notification). But in order to be effective, there must be a unity of effort between the numerous water agencies that currently have overlapping or conflicting mandates.

Principle 5—*Public-private partnerships are the future.* Current trends show that official developmental assistance is declining as the need for investment in water infrastructure is

rising.¹³⁰ Government-raised funds will not be enough to cover the estimated capital expenses. So the job of national governments and IGOs is to create the proper incentive structures to attract private investment in required new infrastructures and generate revenue for the operation and maintenance of existing structures. Governments must also reform the incentive structures that drive unsustainable patterns of water use and pollution (e.g. the price of water, agricultural subsidies, etc.). To the maximum extent, they need to push for integration into the world economy and advance free-trade mechanisms, allowing market forces to more efficiently match production centers with adequate water supplies (i.e. the concept of virtual water whereby water-stressed countries import “water” in the form of food produced in other water-abundant regions). However, such initiatives must be balanced with strong regulatory frameworks that preclude marginalization of the poor (as food prices rise) and safeguard important cultural values (e.g. the rural America lifestyle founded on “cheap” government-provided water).

Principle 6—*A holistic approach that emphasizes cross-sector collaboration will yield the best results.* As noted in Section II, there are interdependencies between the water, agricultural, and energy sectors. Greater cross-sector collaboration will foster more effective resource planning and implementation as well as greater coordination and cooperation between the private sector, NGOs, governments, IGOs, and academic institutions both within countries and across borders.¹³¹

Explaining Technology as a Driving Force

As with water governance, technology as a driving force must be defined. In a broad sense, technology is “the totality of the means employed to provide objects necessary for human sustenance and comfort.”¹³² As a driving force behind conflict or cooperation over shared water

resources, this is somewhat vague. For the purposes of this paper, technology will include the innovation, transfer, and implementation of supply-increasing or demand-reducing initiatives.

Most visibly, technology involves the scientific innovation of new, cutting edge solutions. Much innovation has already occurred. Technologies that reduce demand (efficiency and conservation technologies) or increase supply (desalination and water treatment technologies) are ubiquitous. However, there is currently significant resistance to the adoption of such technologies due to economic and social factors. Limits to financial resources, human capital, and public support or coordination all too often create barriers to their implementation.¹³³

For this reason, the conception of technology as a driving force must be broadened to include methods for overcoming these cultural entrenchments and the natural human resistance to change. Thus, it also involves implementing existing technologies in more locations, at different scales, and in new combinations. It involves new approaches for technical capacity building, training, and education that will lead to regional ownership of solutions and the integration of technological and social systems.¹³⁴ It also involves provisions for transferring technological solutions and the means for implementation to countries that lack the requisite level of human and financial capital. Technology transfer is often complicated due to the sensitive nature of intellectual property rights.

As with governance, several principles are offered to provide the reader a rough insight into what “good” technological innovation, transfer, and implementation might look like in terms of reducing the potential for conflict over shared water resources.

Principle 1—*Emphasize demand-side management and “more crop per drop.”*¹³⁵ Even if technology can effectively expand the world’s water supply for human uses in the long-term (as it has done in the past), the unprecedented nature of stresses on existing fresh water supplies

makes short-term demand reduction a more cost-effective and important option. In most instances, states suffering from water scarcity lack sufficient technological and financial resources for supply-enhancing super-projects. Wisely using the available fresh water resources internal to a country stretches the temporal scale in which external cooperative behavior can develop by slowing progression towards acute water stress and its attendant side-effects. As shown in Section III, cooperative mechanisms take time to initiate and become increasingly less likely as alternatives disappear. Access to pooled resources arising from cooperative agreements can then open the door to more long-term, capital-intensive supply-side solutions.

Principle 2—*Lowering agricultural water use is of primary importance.* Agriculture is both largest and most inefficient water user, accounting for 70 percent of global water use on average.¹³⁶ Only 40% of the water withdrawn actually reaches crops.¹³⁷ It has been claimed that if an order of magnitude reduction in agricultural water use could be achieved, there would be no global water scarcity for the foreseeable future (and hence less potential for conflict).¹³⁸ But progress has been made in very few places. Drip irrigation accounts for only about one percent of all irrigation despite being known to substantially reduce water use relative to flood irrigation (the most common practice).¹³⁹ Other relevant technologies include using recycled waste water, genetically engineering more productive crop varieties, shifting patterns of production to align with climatic realities, bio-engineering of saltwater- and drought-tolerant crops, laser-leveling of terrain to reduce runoff, soil moisture and crop evapotranspiration monitoring in conjunction with irrigation scheduling, improving pumping and distribution infrastructure subsystems, evaporation suppression of reservoirs and canals through and the application of micro-thin surface layers, etc.¹⁴⁰

Principle 3—*Bigger is not necessarily better.* Technological solutions to water scarcity problems must be context-appropriate and cost-effective. Supply side solutions stretch along a continuum from simple point-of-use treatments to large-scale infrastructure projects (e.g. dams and reservoirs, long-distance water transfer canals, etc.) In between are solutions such as rainwater harvesting schemes, micro-pollutant removal through filtration or biological and chemical processes, disinfection with ultra-violet light, recovered water through advanced sewage treatment technologies, desalination technologies, and cloud seeding. Pastoralists in Kenya would arguably benefit more from simple point-of-use treatments that they could take ownership in than a complex sewage treatment facility. Large-scale infrastructural schemes also have their place. Desalination is a viable solution for certain oil-wealthy Middle Eastern states. With sufficient resources, water transfer projects such as those proposed in China and India can also be viable, but consideration must be given to side-effects (e.g. how will the surge in energy consumption from increased desalination efforts affect economic, social and ecological systems, or how water transfer schemes affect the ecological sustainability of a shared water resource).

The Nexus of Driving Forces and Future Trends

Having decided that the form and function of governance and technology are largely responsible for the outcome of international interactions over shared water resources, it must be acknowledged that they do not develop in a vacuum. To be useful in creating realistic future scenarios, the selected driving forces must be analyzed within the larger picture of current and future trends. These trends, while not the most immediate drivers of conflict or cooperation where fresh water is concerned, do have an indirect influence. The following paragraphs introduce a number of trends in terms of their potential impact on all levels of governance and technological adaptation.

Trend 1—*The decreasing robustness of international institutions in response to a changing international system.* The emergence of new powers (e.g. China, India, Brazil, Russia) is shifting the international balance of power towards a multipolar system. Signs indicate a reluctance on the part of new powers to buy-in to the traditional Western international infrastructure, favoring regional blocs and an enhanced strength of nonstate actors and networks instead (businesses, NGOs, religious groups, etc.).¹⁴¹ The resultant dispersion of power and authority could create a global governance deficit. At stake is the future of international water law, IGO mediation, IGO catalysis of cooperative solutions, and IGO assistance for technology transfer and financial resource allocation.

Trend 2—*Global economic restructuring and accessibility to “virtual water” as an alternative to conflict for mitigating water scarcity.* Food trade is an increasingly important policy tool to mitigate water scarcity, with water-abundant countries exporting water-intensive crops to water-short countries.¹⁴² The recent global free trade movement is pressuring most major grain-producing countries to eliminate agricultural subsidies which will raise world food prices.¹⁴³ As global food prices rise, the price of virtual water throughout the food-importing world will also rise. Countries that cannot afford virtual water will be left with fewer cooperative means of achieving their interests.¹⁴⁴ Further, international trade regimes such as the WTO also influence water use by affecting crop choice and cropped area.¹⁴⁵ This could create conditions of water stress in new regions (where governments may or may not have the capacity to alleviate its effects) as farmers attempt to align with the new market incentive structure. Attempts by certain governments (e.g. China) to exploit trade benefits realized through integration into the WTO to achieve national interests could have world-wide impacts.¹⁴⁶

Trend 3—*Protectionism and national self-sufficiency motivations*. This is the counterpoint to Trend 2, and could gain momentum if the current economic recession holds or heightens long enough for governments to enact policies that constrain free trade. For water resources, this would mean increased vulnerability to over-use and degradation. It could also lead to a resurgence of intellectual property rights and financial roadblocks to the transfer of technology.

Trend 4—*Globalization spreads ideas and heightens material expectations of a better life in many developing regions*.¹⁴⁷ As citizens realize what is possible, they demand more from their governments. Governments who can integrate into the global economy and provide for growth will face challenges of dealing with the effects of scarcity as intensified energy, agriculture and domestic demands are placed on water resources. Governments that are already lacking in capacity (to provide for the needs of their citizens) can quickly become overwhelmed and lead to internal instability with the potential to spill across national borders.

Trend 5—*The rise of renewable energy*. States that depend on oil wealth to finance the procurement of fresh water may in the future face decreasing revenues as energy generation shifts toward renewable sources. This describes many extremely water-scarce Middle Eastern and North African countries which currently import or desalinate the majority of their fresh water. Without oil wealth or the ability to capture a similarly lucrative slice of renewable energy markets, these options may become cost-prohibitive and increase competition between states for already overtaxed regional water resources.

Trend 6—*Reliance on groundwater mining as a substitute for establishing cooperative frameworks*. Currently, the most intense effects of water scarcity are being masked by unsustainable withdrawals from underground water resources.¹⁴⁸ If cooperative arrangements

between states are not in place when underground aquifers become unreliable, there may not be enough time or capacity for the lengthy negotiation process to prevent violent conflict.

Trend 7—Increasing privatization of the water sector as a measure to control government spending. On the heels of the recent economic recession, governments worldwide are seeking ways to climb out of debt. Private sector participation in water markets is becoming more common around the world, in part due to historical evidence that public enterprises in any sector are less efficient than private counterparts.¹⁴⁹ But privatization has more often than not been met by stiff resistance by water users based on the perceived conflict of interest between the guiding principles of private firms (water as a profit-driven commodity) and the public interest (water as a right).¹⁵⁰ Poor consumers do frequently end up without adequate services. If governments increasingly choose to privatize the water sector but do not create policy safeguards to prevent the marginalization of certain groups of citizens, domestic instability will increase, as already seen in Bolivia in 1999.¹⁵¹

Trend 8—Non-traditional sources of financing and developmental assistance can undermine efforts to ensure multilateral solutions to shared water problems. Multinational corporations and sub-national governmental entities increasingly have the power to subvert the efforts of the World Bank and other developmental institutions that have adopted a common policy not to fund any project where all the riparian states are not consenting.¹⁵² States with an aggressive stance on national sovereignty and enough capital to bypass development banks achieve the same effect (e.g. China). Such non-traditional sources of financing make it easier for unilateral development projects to move forward—the types of projects that all but stifle cooperative efforts. Unbridled, this trend could be detrimental to the building of basin-wide, joint management frameworks.

Trend 9—*Nationalism and the “internationalization” of water resources*. A trend that has been in the background since the end of the Cold War is nationalism which results in the break-up of states into smaller ethnocentric entities (e.g. the “-stan” republics in the Caucasus region of the former Soviet Union). Water resources that were once under strong central control must suddenly be shared by young states with immature institutions and unconcealed animosities. This conflict-prone scenario was highlighted in the literature review, and the coming years may well see more such internationalized basins emerge (e.g. North-South Sudan or Israel-Palestine or “Kurdistan”-Turkey-Iraq?).

SECTION V – FUTURE SCENARIOS

The following four scenarios use three familiar regions to illustrate how different levels of governance and technology shape interactions between states that must share fresh water resources in an environment of increasing water scarcity. These regions are the Middle East (Turkey-Iraq-Syria), Asia (China-India), and Africa (Sudan-Egypt-Ethiopia). Because the last two scenarios are closely related, the Africa situation is used twice. To highlight the consequences of neglecting good governance and context-appropriate technological adaptation, scenarios in which armed conflict would not necessarily be expected are used to illustrate potential violent interactions. Likewise, a region of simmering tensions is used to illustrate how cooperation could emerge.

Scenario 1: Lemmings with Shoulder Pads -- Low technology and low governance within and between the governments of the Middle Eastern countries Turkey, Iraq, and Syria.

Scenario Introduction: This scenario highlights the interaction between countries whose behavior, when viewed in hindsight, resembles stereotypical lemmings. As with lemmings that are unable or unwilling to stop their momentum, seemingly content to shuffle along to their

doom at the bottom of a cliff, states without the institutional capacity or technological adaptability to deal with water scarcity march inexorably towards social, economic, and environmental disaster. These scenario lemmings are also given shoulder pads due to a tendency to collide with each other on their way towards the cliff edge, just as states lacking in peaceful means for achieving water security often resort to violent conflict.

Scenario Narrative: In 2011 the US withdraws militarily from Iraq. Despite stumbling along a quasi-democratic path for five years, instability gradually increases and levels of foreign direct investment drastically decline. This hurts the economic sector as well as the government's ability to provide public services. Political turmoil becomes the norm as the government coalition turns into a Shia-dominated oligarchy that systematically alienates the Kurdish and Sunni minorities. Within the country, the average Iraqi's initial delight at the departure of the coalition forces is replaced with a feeling of betrayal by the West. Corruption becomes rampant among government officials and elections are farcical by 2015. Iraq's water infrastructure continues to deteriorate as the Ministry of Water Resources (MWR), in a state of extended flux, is unable to update laws passed in the 1960s and 1980s despite repeated shifts in regimes, experience of war, and a population that is almost double in size.¹⁵³ No coherent national water policy ever emerges, and ad hoc policies only marginalize portions of society, industry, and agriculture. In 2017, irrigation canals and dam reservoirs are heavily silted, and a large percentage of surface waters are polluted from agricultural run-off. Farmland in the south is degraded from soil salinity due to the use of flood irrigation and drainage systems in disrepair.

Throughout the 2010s, Turkey proceeds with its GAP project, spending millions on enormous supply-side infrastructure improvements that further aggravate water quantity and quality problems in downstream Iraq and Syria who are heavily dependent on the shared waters

of the Tigris and Euphrates Rivers. When denied financial assistance from the World Bank (which was contingent upon the consent of all affected riparian countries), Turkey turns to China for construction assistance and funding. By 2015, China has made considerable investments in Turkey and ties between the two countries are increasing. Meanwhile, Turkey continues to neglect demand-side solutions, having never improved irrigation efficiency beyond a meager 50 percent.¹⁵⁴ With an additional 75 million people added to their population by 2017, Turkey avails itself of an ever increasing portion of the shared river water to increase their irrigated agriculture acreage and in that year released less than 15 km³ of water across the border into Syria for the first time. Although not formalized in a treaty, Turkey had promised a minimum of 15.75 km³ during earlier negotiations.¹⁵⁵ Less water to Syria also means less for Iraq.

Given Iraq's growing instability, the Strategic Cooperation Council between Iraq and Turkey is abandoned in 2012. In the absence of high fidelity data on the state of their shared water resources, all sides assume the worst and finger-pointing intensifies. The effects of climate change on rainfall and run-off patterns contribute to the over-allocation of the Tigris and Euphrates, which fails to reach the Persian Gulf for the first time in 2015. The city of Mosul in northern Iraq, largely populated by Kurds, feels the effects first, and after two summers of severe drought in 2016 and 2017, pressure on the Iraqi government to respond reaches an all-time high. Simultaneously, separatist Kurdish groups led by the PKK increase their disruptive incursions into Turkey. Turkey loses any remaining interest in being a "good neighbor," which had led them to a one-time goodwill increase of flows to Iraq after a similar drought in 2009. The Iraqi government publicly announces its intention to contain the Kurds, but is increasingly unable to do so due to Kurdish resentment of underrepresentation at the hands of the Shia-dominated government.

As these developments unfold, international governance suffers its own setbacks. NATO and the UN, despite petitions by Syria and Iraq to force Turkey to release more water, are never seriously inclined to intervene. The traditional international institutional leaders—US and Europe—are preoccupied with internal affairs as they deal with societal change, demographic shifts, and deteriorating social cohesion. NATO is showing signs of break-up as members openly disagree on the organization's increasing commitments in non-traditional regions and roles. The UN Security Council resolves to take no action in 2015 and again in 2017 due to China's veto—signs of a seeming reluctance for the emerging power to shoulder global responsibilities. China is determined to protect their investments in Turkey, to show appreciation for Turkey's one-China policy concerning Taiwan, and to avoid setting a precedent of international intervention in transnational water issues given their own development dispute with India and Bangladesh over a unilateral project to divert the Brahmaputra River. Further, Syria and Iraq have no recourse to International water law, since Turkey is not a signatory to the 1997 UN Convention on International Watercourses.¹⁵⁶ Turkey invokes the principle of absolute territorial sovereignty to justify their actions, and continues to lower the level of Tigris and Euphrates water flowing across their border into Syria and Iraq as 2017 turns into 2018—and more drought.

In August of 2018, Kurdish separatists attempt to blow up a dam in southeastern Turkey. The Kurdish provincial government and the government of Syria only thinly veil their denial of involvement in the attacks. Turkey responds by bombing Kurdish settlements within Iraq without the approval of the Iraqi government. Waves of water induced migrations into Iran and Syria threaten to escalate the conflict.

Scenario 2: The Lone Wolf with Pocket Protectors -- high technology but low governance concerning physical water scarcity in China and India.

Scenario Introduction: This scenario highlights the potential for technological adaptation (symbolized by traditional “geek” garb such as pocket protectors) to stave off the effects of water scarcity long enough for cooperative mechanisms and more efficient sharing of a resource to develop. But technology by itself is inadequate in the absence of a functional framework for joint management and dispute negotiation—the lone wolf who survives the summer on small prey by going it alone will eventually require the assistance of the pack to bring down an elk in the middle of winter.

Scenario Narrative: After decades of emphasis on education in the sciences and engineering, in 2015 China develops a revolutionary desalination technique based on membrane technology that is both cost and energy efficient. With this new source, they are able to provide fresh water to meet all coastal city needs. This frees up river water for agricultural irrigation and eases cases of domestic violence that were on the increase throughout the early 2010s (farmers deprived of water rioted with police and local officials who they viewed as representatives of the government responsible for their misfortune). It also decreases the growing enthusiasm for South to North transfer schemes that would divert water from the Brahmaputra or Mekong Rivers to the drought-stricken agricultural centers of northern China.¹⁵⁷ Such unilateral development projects would have devastating economic and humanitarian repercussions in downstream India and Bangladesh.

Taking advantage of newfound “breathing room,” negotiations towards China’s inclusion in the Mekong River Commission (MRC) and the establishment of a China-India-Bangladesh joint management framework continue. These negotiations ultimately stall, however, as China is

emboldened by their technological successes that soon carries over into irrigation efficiency and crop productivity. Government policy becomes the more aggressive pursuit of agricultural self-sufficiency. China is still extremely protective of its new technologies, seeing them as a source of strategic power and economic profit. A sort of “water umbrella” emerges in the region, with China offering water security to strategic allies (e.g. Pakistan and Iran but not India). As a side-effect of their decision to abstain from integration into regional water boards, no regional scientific and information exchange relationships that could potentially take advantage of new Geographic Information Systems (GIS) and remote sensing technologies are formed. This translates into a missed opportunity to obtain a better assessment and understanding of the nature region’s shared water resources (and the early detection of threats to these precious water supplies). Due to the closed nature of China’s regime, international institutions are frustrated by a sense of powerlessness—IGOs that might otherwise encourage cooperation, mediate disputes, or provide a central forum for the transfer of water technologies by buying down intellectual property compensation fees.

Across the Himalayas, India, which is quite capable of developing technological solutions to water efficiency and supply problems on its own, continues to lack the political will to prioritize their implementation. Despite significant growth in the industrial sector, agriculture remains a victim of India’s cultural predilection for the village as the basic organizational unit and caste politics.¹⁵⁸ Culturally entrenched corruption institutionalizes the marginalization of the poor as only the rich get electricity for irrigation pumps, food subsidies, etc.—in some places less than 25 percent of government spending is actually used to improve public services such as access to water (rainwater harvesting systems, etc.).¹⁵⁹ These trends continue throughout the 2010s into the 2020s. Having achieved basic food self-sufficiency with the Green Revolution in

the 1970s, water remains a low national priority despite evidence of increasing population pressure.

Climate change accelerates more quickly than anticipated and the melting of Himalayan glaciers (that feed all of the region's important rivers) accelerates, catching regional leaders off guard about the time populations are peaking in 2025. Monsoon patterns become wildly variable in India. Without the early detection of these climate trends and their effects on water resources that might have arisen from regional data sharing and joint water planning, there is no time for a coordinated response. Subscribers to Murphy's Law might view this ironically—as a punishment of sorts for neglecting national and regional water governance in the euphoria of technological improvements. Agriculture collapses in China and its leaders desperately seek a way to retain their hold on the regime amid growing unrest. They first turn to imports, but the resultant shock on world food production causes food prices to skyrocket.¹⁶⁰ It is quickly apparent that imports alone are insufficient given the scale of food required to feed China and a world production system that has contracted in response to the reversal of trade liberalizations over last decade (largely driven by Chinese self-sufficiency aims and Western protectionism following the global economic recession). India's food production also lags and their grain reserves are depleted. Groundwater mining—the short-term solution of choice for both China and India—cannot alleviate the effects of climate change as aquifers are depleted.

In the end, beset by internal instability, both countries find themselves back at square one—seeking to exploit a greater portion of shared river water through unilateral development. China eyes the Mekong and Brahmaputra which affects India, Bangladesh, and the nations of Southeast Asia, and India turns to the Indus which affects Pakistan. At the same time, environmental migrants from Bangladesh, North China, South and West India, and Pakistan

intensify regional tensions. Advancements in water reuse and treatment technologies reduce the humanitarian impact of these refugees, but it is too little too late.

Scenario 3: Prairie Dog Ghost Town -- low technology but high governance between the African countries of North Sudan, South Sudan, Egypt, and Ethiopia.

Scenario Introduction: This scenario highlights the ability of good governance to mediate a cooperative solution to problems of sharing water resources, even in a region characterized by pre-existing tensions that would otherwise almost certainly deteriorate into a relapse of violent conflict. Communities of prairie dogs survive through cooperation in surveillance, communication and the construction of an elaborate system of interconnected burrows. But sometimes this is not enough and entire communities disappear, leaving behind only traces of their well-organized existence—prairie dog ghost towns. One wonders if some new adaptation would have averted their death or migration, just as technological adaptation is increasingly required to supplement good governance efforts in the face of exponentially increasing pressures on water resources. This scenario focuses on governance in the short term.

Scenario Narrative: The international community convinces South Sudan to delay its referendum for independence, initially scheduled for January 2011¹⁶¹, in order to complete negotiations on potential flashpoint issues that would almost certainly result in renewed civil war. In exchange, the African Union (AU) and the UN agree to send a stabilizing force to the border region. The negotiations center on oil revenue and the construction of the Jonglei canal—a proposed canal to transfer water from the water-rich southern Sudan to the more water-scarce regions of northern Sudan and southwestern Egypt. Currently China imports one tenth of its oil from the south of Sudan through its ties with the authoritarian Sudanese government of Omar al-Bashir in Khartoum.¹⁶² Egypt and Khartoum also believe that they need to transport water from

the extensive White Nile-fed swamps in the south of Sudan to the north for increased irrigation and economic development. They fear that the creation of an independent South Sudan would threaten their current water sharing arrangements set forth in a 1959 treaty that notably excludes all other Nile riparians (including Ethiopia).¹⁶³ Conversely, citizens in the south are expected to continue to receive little to no compensation or improvements in living conditions in exchange for oil and water withdrawn from their territory.

Negotiations initially produce inconclusive results as the South Sudanese Liberation Movement (SSLM) and the al-Bashir regime remain antagonistic towards each other. The Jonglei canal becomes a symbol of their differences. In the summer of 2012, a South Sudanese grassroots movement, emboldened by the stabilizing presence and attention of the international community, elects new leaders who are not associated with the SSLM. China, still driven by its oil interests, reads the strategic political situation and decides to pursue stronger ties with South Sudan. Early signs of a developing responsible and proactive government in South Sudan make it easier for the US and EU to officially support the creation of an independent South—a step which could bolster influence in the region without displaying tacit support for al-Bashir's authoritarian regime that was heretofore the only recognizable government in Sudan. General al-Bashir, increasingly isolated by world opinion after Darfur and the presence of the international stabilizing force, begins to lose his authoritarian hold on the North. Citizens of the North are encouraged that authoritarianism in Khartoum is not something that they are doomed to live with. Fatigued by war and aware of the current regime's inability to cope with impending environmental and social disasters (given their track record in two civil wars and genocide in Darfur), these citizens demand greater transparency of the government in providing for their needs and generate strong internal pressure for cooperation with the South over water—it is in

fact water that initially brings the North to the negotiating table. In January of 2013, al-Bashir agrees to step down in exchange for immunity from the International Criminal Court (ICC) which seeks to prosecute him for crimes against humanity. The international community agrees.

Taking advantage of these initial steps to depoliticize the water issue, Egypt takes a leadership role and organizes basin-wide discussions among *all* countries with a stake in the Nile using the framework of the Nile Basin Initiative (already in-place but characterized by inactivity in recent years). This allows negotiations between the North and the South to move forward at an accelerated pace over the course of the next year. Compromise is finally reached through issue linkage—South Sudan agrees to allow the Jonglei canal to be constructed (to the benefit of Egypt and North Sudan) in exchange for a larger portion of oil revenue in the South. North and South Sudan become separate states in late 2014. Success breeds success, and all Nile riparian countries agree to continue efforts to transform the Nile Basin Initiative into a regional joint planning and management organization to generate the greatest possible benefit for all from shared Nile waters.

Emergence of responsive, transparent governments in Sudan attracts foreign investment at a surprising rate. Official developmental assistance from the World Bank and IMF along with state-sponsored Chinese investments enables rapid improvement in water infrastructure in South Sudan. A period of significant economic growth, improvement in access to public services, and expansion of the fledgling industrial sector ensues. The agricultural sector in particular enjoys increasing importance as both China and Saudi Arabia look to Sudan as a potential breadbasket for importing “virtual water” to alleviate their water scarcity problems.

Eventually, better governance and equitable distribution of benefits from the region’s water is found to be not enough. In 2020, water pollution due to inefficient agricultural practices

and economic expansion, and variable flows due to changing climate patterns once again threaten a stable division of water in the region. Technological improvements in use efficiency and supply supplementation are needed. The prospects for such technological adaptations are high, however, given the emergence of common interests throughout region and displayed political will to manage water resources sustainably.

Scenario 4: Honeycomb—Patent Pending -- high technology and high governance in Africa.

Scenario Introduction: This scenario is an extension of the previous narrative, but with a longer-term perspective. It shows how technological adaptations often follow closely on the heels of good governance, creating synergistic effects that alleviate the potential for conflict over shared water resources. Bee hives are remarkable examples of what can be achieved through cooperation—much more than an individual bee could expect to achieve on its own. Similarly, joint management of shared water resources can provide win-win outcomes for all states involved. Bee hives, however, owe their stability to an impressive biological structural innovation—honeycomb, just as the combination of effective governance and high levels of technological adaptation provide states the best long-term capacity for dealing with water scarcity.

Scenario Narrative: As in the previous scenario, South Sudanese independence and the North's renewed talk of resuming the Jonglei canal project incite regional tensions along a North Sudan/Egypt -- South Sudan/Ethiopia line. However, Egypt does not step in as a regional leader in water negotiations. Tensions simmer, but all parties are restrained from resorting to violence by a sense that “the entire world is watching.”

Between 2010 and 2015, China makes good on its Copenhagen pledge to reduce its carbon intensity and support international efforts to address climate change. Propelled by

advances in clean energy (and the jobs created in the sector), the US Congress finds it politically viable to also take a global leadership role. US-China collaboration reinvigorates the Intergovernmental Panel on Climate Change (IPCC), which increasingly recognizes the effects of climate change on water resources. In 2015, the IPWS (International Panel on Water Scarcity) is formed at the UN on the model of the IPCC. Following the disastrous outcome of interactions over shared water resources between Turkey and Iraq in 2017, The IPWS uses its emerging leadership to push for global acceptance of the Delhi Rules—an updated international water law based on the UN Convention and the Berlin Rules. The US, EU, China, India, and Brazil are among the first signatories. Following this high-powered example, a host of developing countries ratify in rapid succession including Egypt, Ethiopia, and the Sudans. The IPWS and the Delhi Rules quickly become a normative force for depoliticizing disputes over shared water resources—both surface *and* groundwater. It also serves as a central body for the collection, analysis, and sharing of data on water resources, as well as for the transfer and implementation of water supply and efficiency technologies.

Headquartered in Cairo, the IPWS sees the water dispute in Sudan as an opportunity to apply its expertise in its own backyard. Using the Nile Basin Initiative (NBI) and the World Bank sponsored ICCON (International Consortium for Cooperation on the Nile) and Nile Basin Trust Fund, the IPWS establishes a joint Nile monitoring and information exchange program that in short time shifts the basis for interactions over shared water resources from political-based verbal threats and outdated or dysfunctional water allocation schemes to a science-based joint planning and management initiative. Based on IPWS provided data that predicts long-term decreases in rainfall in Ethiopian highlands (that feed the Nile) if the swamps in South Sudan were drained, plans for the Jonglei canal are scrapped. Instead, joint development funds are used

to create new reservoirs upstream in Ethiopia that will provide hydropower to Ethiopia and South Sudan for development, lose less water to evaporation at higher altitudes, and reduce siltation of the Aswan reservoir by trapping it upstream—all measures that will increase the overall availability of water in the Nile basin (including Egypt and North Sudan who advocated the Jonglei).

In addition, a permanent Agriculture Council is established as part of the NBI and staffed by experts from the US, Israel, and India. This council gives all states in the basin access to irrigation expertise tailored to their specific socioeconomic context. Using the Nile Basin Trust Fund, intellectual property rights for privately developed water-related technologies are purchased for adaptation in the region. The Council's achievements are many. The national water policies of North and South Sudan are overhauled to slow pollution and achieve more equitable inter-sector water allocation. Rainwater harvesting methods are introduced into South Sudan and Ethiopia. Point-of-use water treatment technologies extend access to safe water and sanitation, which goes a long way towards setting the conditions for alleviating poverty. Over time, more productive and drought resistant crop varieties, efficient irrigation systems, nanotechnologies for monitoring soil moisture and allocating water to crops, efficient water storage innovations, and bioengineering methods to reclaim wastewater create a green revolution in the Nile Valley that greatly contributes to the economic modernization of North and South Sudan and Ethiopia.

As Libya and Chad modernize in the 2020s, they rely primarily on unsustainable withdrawals from the Nubian Sandstone Aquifer System (NSAS)—the largest deposit of fossil fresh water in the world that underlies Libya, Chad, Egypt, and Sudan. The drawdown of the NSAS, primarily by Libya and Chad, lead Egypt and the Sudans to integrate these two non-Nile

countries into the NBI cooperative framework. A collective, regional view of its extensive fossil aquifers emerges as being a source of insurance against emergencies.

In line with the adage “no news is good news,” this previously conflict-ridden region of sub-Saharan Africa enjoys decades of regional peace and prosperity out of the media spotlight.

SECTION VI – DISCUSSION AND CONCLUSION

A nation that fails to plan intelligently for the development and protection of its precious waters will be condemned to wither because of its shortsightedness. The hard lessons of history are clear, written on the deserted sands and ruins of once-proud civilizations.

–Lyndon B. Johnson, 1968

A nation’s first duty is within its borders, but it is not thereby absolved from facing its duties in the world as a whole; and if it refuses to do so, it merely forfeits its right to struggle for a place among the people that shape the destiny of mankind.

–Theodore Roosevelt

[T]o the people of poor nations, we pledge to work alongside you to make your farms flourish and let clean waters flow; to nourish starved bodies and feed hungry minds.

–Barack Obama, 2009

This section will discuss how water scarcity (both at home and abroad) affects US national interests. It will also consider how US foreign policy can benefit by taking a more strategic view of water. In this role, water must sometimes be addressed from the perspective of a problem to be managed (so as to not prevent the achievement of national interests). At other times, however, it should be seen as a potential tool that can directly assist in the achievement of national interests.

US Interests and Links to Water

So what are US national interests, and how is water related to them? In 2000, a bipartisan Commission on America’s National Interests produced a document that expresses national interests in terms of a hierarchy--vital, extremely important, and important.¹⁶⁴ Vital national interests are defined as “conditions that are strictly necessary to safeguard and enhance

Americans' survival and well-being in a free and secure nation.”¹⁶⁵ Likewise, extremely important interests would, if compromised, “severely prejudice but not strictly imperil” Americans' survival and well-being, while important national interests “would have major negative consequences” on the same.¹⁶⁶ Three specific vital interests listed in the document would be directly impacted by instability or conflict due to water scarcity—preventing the emergence of failed states on US borders, ensuring the viability and stability of major global systems (trade, energy, the environment, and financial markets), and establishing productive relations with nations that could become strategic adversaries such as China and Russia. Specific “extremely important” interests with ties to state interactions over water include promoting the acceptance of international rules of law and mechanisms for resolving or managing disputes peacefully; promoting democracy, prosperity, and stability in the Western Hemisphere; preventing, managing or ending major conflicts in important geographic regions; and preventing massive uncontrolled immigration across US borders. Lastly, specific “important” national interests that can be linked to water include discouraging massive human rights violations in foreign countries; preventing or ending conflicts in strategically less significant geographic regions; promoting international environmental policies consistent with long-term ecological requirements; and reducing the economic gap between rich and poor nations.

The linkages between water, water scarcity, and state interactions over shared water resources and the above discussion of America's national interests are perhaps most readily perceived in terms of survival and security of the homeland. This paper has shown how, in some cases, water disputes can exacerbate existing tensions and lead to violence. Thus it is no stretch to understand how alleviating the negative effect of water scarcity within its own borders and in

its immediate backyard concerns US interests. While the threat of a failed state or mass humanitarian migration across US borders is not an immediate concern, relationships with Canada and Mexico should nevertheless not be neglected. Cooperation over shared water between the United States and Mexico (as established by the 1944 water sharing treaty for joint use of the Colorado and Rio Grande Rivers) has begun to show signs of strain.¹⁶⁷ Mexico has in the past defaulted on obligations to release the required amount of Rio Grande water to the United States. Conversely, Mexico has been negatively affected by the level of salinity and pollution of Colorado River water entering from the United States.¹⁶⁸ These two rivers provide a significant portion of the water supply used for food production and urban consumption in the arid western United States and northern regions of Mexico. Without collaboration, regional leadership and technical assistance from the United States, it is not unthinkable that added water stress due to climate change and population increases in combination with existing governance problems due to the presence of drug cartels could increase instability in Mexico.

When economic prosperity concerns are added to the list of national interests, US involvement in alleviating the potential of conflict due to water scarcity in key strategic regions elsewhere around the globe also begins to make sense. Water is a key driver of economic stability and prosperity through its structural linkages with the agricultural, energy and industrial sectors—thus ensuring its availability and quality is critical.¹⁶⁹ Water development also represents a potential commercial interest since “by virtue of their technologies and innovations, a number of US-domiciled companies are well positioned to play an important role in addressing the global water challenge” in an industry “valued at between \$360 billion and \$540 billion” and expected to grow by almost 6% between 2010 and 2014.¹⁷⁰ Currently, developing countries in which water scarcity and governance concerns intersect trace an arc of potential instability across

South Asia, the Middle East, North Africa, and sub-Saharan Africa.¹⁷¹ US interests are linked with many of these countries through energy imports from the Middle East and North Africa, the desire for a strong, democratic India to counterbalance a recently more assertive China, the importance of a well-governed Pakistan as a key state in nuclear nonproliferation concerns and as an ally in the fight against global terrorism, trade relationships with China and India as the basis for a healthy US economy, or the growing importance of global food trade and the damaging effect that agricultural collapse in countries with large populations would have on food prices worldwide.

Above and beyond these realist concerns, however, there are ethical and superpower obligations that will demand a US response in almost every situation where water scarcity affects human livelihoods and social systems. Like it or not, America views developmental assistance and humanitarian aid as moral obligations. These obligations are institutionalized in agencies such as USAID and the Millennium Challenge Corporation.^{172,173} It is why we will continue to offer financial aid, technological expertise, and governance advice to hot spots around the world such as Sudan as illustrated in the scenarios above. This ethical motivation is in some ways tied to America's superpower obligations. The world demands that the United States show leadership in areas where it has virtually no security or economic interests as part of its responsibility (and cross to bear) for its status as the preeminent world power. Max Boot noted that after the Cold War, getting involved in the affairs of developing countries has been a prime source of political controversy, surmising that many explain the reluctance for involvement in Kosovo, Rwanda, or Darfur as stemming from the absence of any national interests in these areas.¹⁷⁴ However, it all depends on how one defines national interests, which is a matter of individual judgment. Boot argues that "history suggests that the US has never confined [its

involvement] to situations that meet the narrow definition of American interests preferred by realpolitikers and isolationists. It is doubtful that American leaders can resist the call for similar humanitarian interventions in an age when the public back home knows far more about horrors being perpetrated in the far corners of the world than it did in the Victorian era” when Britain battled the common enemies of mankind.¹⁷⁵ He ends these thoughts by saying that “whatever you call it, this represents an idealistic impulse that has always been a big part in America’s impetus” for action.¹⁷⁶

To those who would argue that any such ethical or world leader motivations for becoming involved in preventing or mediating water disputes are simply “niceties” that will fade in importance during times of ballooning federal debts and deficits—such as the current era of backlash against “big” government—a simple question should be posed: how does the price tag on a policy of picking up the pieces after countries fail or become devastated by conflict compare to one of extending a dose of preventative medicine? It is this author’s opinion that the latter is much more cost effective and more aligned with America’s interests and foreign policy strategy.

In fact, many US policy documents take a rather liberal view of US interests. These policy documents are where any interpretation of national interests and strategies for achieving them must begin. The *2006 National Security Strategy* (NSS) says that “the goal of our statecraft is to help create a world of democratic, well-governed states that can meet the needs of their citizens and conduct themselves responsibly in the international system.”¹⁷⁷ More currently, the *2010 Quadrennial Defense Review*, as a reflection of the yet to be released 2010 NSS, says that the “strength and influence of the United States are deeply intertwined with the fate of the broader international system... [The US] must therefore be prepared to support the broad national goals of promoting stability in key regions, providing assistance to nations in

need, and promoting the common good.”¹⁷⁸ Such ideas are also encapsulated in public law. US Title 22, Section 2151 of the US Code concerns developmental assistance:

The Congress finds that fundamental political, economic, and technological changes have resulted in the interdependence of nations. The Congress declares that the...economic prosperity and security of the people of the United States are best sustained and enhanced in a community of nations which...work together to use wisely the world’s limited resources in an open and equitable international economic system. Congress reaffirms the traditional humanitarian ideals of the American people and renews its commitment to assist people in developing countries.¹⁷⁹

Recommendations

So what should US water strategy and policy look like? It has been shown that water underpins many of our national interests. For this reason, it can be argued that water has evolved into a strategic resource.¹⁸⁰ As such, US foreign policy would benefit from employing water in a more strategic role as opposed to just paying the concept lip service. This deserves a bit of explanation.

Many documents highlight the connections between US strategic interests abroad and intensifying international water challenges. For example, Title 22, Section 2152h of the US Code expresses the goal of promoting “economic development, poverty reduction, conflict prevention, and environmental sustainability by providing assistance to expand access to safe water and sanitation [and] promoting integrated water resource management.”¹⁸¹ Also, a CSIS report notes that water is a critical component for any foreign policy strategy:

It is clear that water scarcity, water quality, and water management will affect almost every major US strategic priority in every key region of the world. Addressing the world’s water needs will go well beyond humanitarian and economic development interests. Virtually every major US foreign policy objective—promoting stability and security, reducing extremist violence, democracy building, post-conflict stabilization and reconstruction, poverty reduction, meeting the UN Millennium Goals, combating HIV/AIDS, promoting bilateral and multilateral relationships—will be contingent to some extent on how well the challenge of global water can be addressed.¹⁸²

So water, if leveraged adroitly in foreign policy, can advance vital national interests—addressing water scarcity challenges worldwide is not just something that falls into the “would be nice to do if nothing else more important prevents the allocation of limited resources” category.

However, harnessing the importance of water to help achieve national interests is rarely exercised. A recent study on global water futures indicated that water policy has for too long been relegated to a sort of second-tier strategy realm—that of humanitarian and foreign assistance.¹⁸³ The study calls for elevating the role of water to “an element integral to promoting and realizing its broader national interests and foreign policy agenda.”¹⁸⁴ Specifically, it calls for three action items: to reformulate the vision of how water impacts US foreign policy within geopolitical realities; to retool organizational structures and processes by which international water policy is formulated and implemented; and to strengthen cooperation with elements outside the US government (foreign counterparts, IGOs, NGOs, international development institutions, and the private sector) to develop solutions commensurate with the magnitude of the water challenges facing the world.¹⁸⁵

In passing the *Water for the Poor Act of 2005*, Congress took a step in right direction. The Act requires the Secretary of State, in consultation with USAID and other US Government (USG) agencies “to develop and implement a strategy to provide affordable and equitable access to safe water and sanitation in developing countries within the context of sound water resources management.”¹⁸⁶ In the five years since the passage of the Act, the Department of State (DOS) has attempted to ensure better coherence in planning, allocation, and monitoring of water-related US foreign assistance by developing a joint framework to synchronize USG efforts.¹⁸⁷ There is

room for improvement. Only the first steps in a long-term process have been taken. Below are a few recommendations for the future.

First, more emphasis should be placed on nurturing cooperation over shared water resources and governance in volatile regions. In 2007, the stated objectives of US water policy were threefold—increase access to safe water, improve water management and productivity, and improve water security by strengthening cooperation on shared waters.¹⁸⁸ By 2008, however, the water-security and cooperation objective had disappeared.¹⁸⁹ The USG continues to emphasize a country-centric strategy in responding to international water challenges at the expense of regional level cooperation. Access to safe water and in-country water management are important to maintaining internal stability, but this report has shown that cooperation across borders will be required to address future water scarcity challenges. Reflecting on the Turkey-Iraq-Syria scenario, it should be noted that the absence of a military presence in Iraq does not relieve the United States from other forms of involvement in the region. Rather, as military presence wanes, diplomatic and other forms of foreign assistance should increase to counterbalance the natural tendency for a void in governance to emerge. Just as the United States mediates negotiations between Israel and Palestine, the world's sole superpower can assist the development and maintenance of cooperative ties between a new Iraq and its neighbors. The first steps in establishing a long-term, cooperative relationship over shared waters are currently being taken in the region, but future neglect will threaten recent efforts as well as jeopardize US interests.

Second, there needs to be a stable source of financing for water-related assistance, and it needs to be significantly larger than current levels. The *Water for the Poor Act* in essence created an unfunded mandate by not providing for a dedicated budget allocation.¹⁹⁰ Rather, the Act relies on existing financial arrangements of the agencies involved—of those, only USAID,

the Millennium Challenge Corporation, and the DoD receive direct appropriations related to water.¹⁹¹ Water-related funding rises and falls with time, creating budgetary uncertainties that hamper the efforts of water planners. For example, total USAID spending, which comprises the lion's share of total water-related spending, was roughly \$400 million in 2004 (prior to the Act's passage), but fell to \$263 million in 2007.¹⁹² With limited funding, the Act has been unable to positively address the uneven distribution of foreign assistance. For example, roughly \$1.5 billion was spent in 2008 on water infrastructure in Iraq (due to supplemental DoD appropriations) while \$815 million in total aid was spread across 95 other countries.¹⁹³ An important question needs to be asked—do current levels of water-related spending appropriately reflect the importance of water in achieving US interests? As mentioned above, failed states and conflict clean-up are much more expensive in the long-term than preventative, developmental assistance now. Reflecting on the Sudan scenario, a tremendous amount of foreign investment will be required to ensure equal access to water for both personal quality of life improvements and development and economic growth at the national level—investments in physical infrastructure as well as in human capital to share expertise and implement functional water management institutions. Without such investments, future water problems will only exacerbate existing tensions in this volatile region and the desirable scenarios described above will never be realized.

Third, formally coordinating the immense expertise within the disparate agencies and departments would allow for unity of effort and synergistic multiplication of effects. Coordination between the DOS and USAID on water developmental assistance and aid has improved, but coordination within the USG at large is still lacking—more than 15 agencies and departments are involved in international water issues.¹⁹⁴ Although regional priorities have

emerged to focus agency efforts, they do little to prevent duplication of effort.¹⁹⁵ Furthermore, there is little unity of effort with agencies outside of the USG such as IGOs, NGOs, private corporations, etc.¹⁹⁶

Fourth, new and innovative approaches to water are needed, not just a simple expansion of current efforts.¹⁹⁷ US foreign assistance, of which water is a key element, needs to be more overtly *integrated* into US foreign policy goals. Certain aspects of foreign policy can even be built *around* water. In contrast, *The Water for the Poor Act*'s yearly progress reports to Congress still reflect a current mindset of inserting water-related issues into larger foreign policy on an ad hoc basis. Water can bring disputing parties to the negotiating table as shown in both the Literature Review and Future Scenarios sections above. Just as neighboring countries that cooperate over water begin to realize shared interests, so could an emphasis on water bring America and countries with which relations have been prickly to a better understanding as the effects of water scarcity begin to intensify in the near future. Related to this, water assistance can be no-strings attached part of foreign policy that clearly and unambiguously communicates America's good will and commitment to people and their governments without invoking the "ulterior motive" genie that so often taints American involvement worldwide and negatively colors world opinion—especially in the Middle East. The United States could use this goodwill to gain influence and allies (and in the process secure national interests) without politicizing issues. It should be fairly apparent that the negatives associated with the Turkey-Iraq-Syria scenario above could be alleviated by such an approach to foreign policy in the region.

Finally, more than anything else, both the US and the world need sustained leadership on the issue. The China-India scenario shows how technological solutions that temporarily ease tensions over shared water resources might not be sufficient in the long-term. Continual,

positive steps need to be taken to build adaptable water management institutions across political boundaries at the watershed scale. In the absence of such institutions, unforeseen changes to water resources will inevitably become a source of potential conflict. While recent changes to US water policy show promising foresight, the challenges of water scarcity will significantly affect US strategic interests both at home and abroad for decades to come.¹⁹⁸ Solving water scarcity problems and simultaneously leveraging US foreign assistance and regional/world leadership to advance our national interests will require sustained political will. Climate change, population increases, and economic development are advancing at increasing speed, so the time to act is now.

Conclusion

In attempting to assess the potential of water scarcity to incite conflict between states that must share transboundary fresh water resources, this paper has developed four main themes.

The first is that water problems are here to stay. The background section illustrated how increased demand from population and socioeconomic pressures and dwindling or variable supplies from over-use, pollution, and climate change have brought the effects of water scarcity to a tipping point in many parts of the world. A current issue of National Geographic dedicated to water observed that “either we learn to live within nature’s increasingly unpredictable means, we move elsewhere, or we perish.”¹⁹⁹ But solutions abound if sustained leadership on the issue can be realized. The same magazine surmises that: “We may not get all the water we want. But we can have the water we need. The planet is a long way from dying of thirst.”²⁰⁰

The second main theme is that the potential for water-induced conflict—even violent conflict—within and between states exists. However, there is an equal if not greater potential for water to act as a cooperative impetus. Either way, some level of instability is virtually assured,

necessitating a focus on prevention and emergency responses. Environmental water refugees have already taken a toll in lives and required massive humanitarian assistance efforts around the globe (e.g. Sudan). Pacific Institute's Peter Gleick puts the conflict-cooperation debate into perspective: "It's inevitable that we'll solve our water problems. The trick is how much pain we can avoid on that path to where we want to be."²⁰¹

The third theme is that to have the greatest impact in preventing conflict and instability in situations of shared water resources, focus should be placed on governance at all levels, especially more robust water governance institutions at the regional/watershed level. A second focus area should be scale-appropriate technological adaptation aimed less at mammoth supply-side projects such as supersized dams, aqueducts and pipelines that deliver water over huge distances, and more towards a softer, comprehensive approach "that includes conservation and efficiency, community-scale infrastructure, protection of aquatic ecosystems, management at the level of watersheds instead of political boundaries, and smart economics."²⁰²

The fourth and final theme is that US interests are, and will continue to be, threatened by the negative effects of water-scarcity. In line with the adage "an ounce of prevention is worth a pound of cure," the United States would benefit from a more strategic view of water, especially in foreign policy. US security and economic interests at home and abroad are threatened by outright conflict between—as well as internal to—states in key strategic regions of the globe. In addition, ethical and superpower obligations will tip the scale to favor US involvement in even seemingly unimportant (in terms of national interests) corners of the world. Extending a helping hand to water-stressed countries can also aid in the attainment of other foreign policy objectives. In their report addressing global water futures, the CSIS writes:

While the debate over water as a potential cause for war in the future continues, the fact remains that water scarcity and poor water quality are destabilizing forces that impact

both economic and social stability. Facilitating cooperative arrangements over shared water resources not only diminishes these disruptive forces but also provides avenues for cooperation and political development in other spheres.²⁰³

It is the conclusion of this research project that such a level of cooperation represents the desired future scenario.

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⁵ Organization for Economic Cooperation and Development, Development Assistance Committee (OECD DAC), "Water and Violent Conflict," 4.

⁶ CSIS, "Addressing Our Global Water Future," 9.

⁷ UN WWAP, "Water in a Changing World, Ch 1," 19.

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⁹ Tully, "Water Water Everywhere," 343.

¹⁰ Pimentel et al., "Water Resources: Agricultural and Environmental Issues," 909.

¹¹ Ibid., 910.

¹² UN WWAP, "Water in a Changing World, Facts and Figures," 11.

¹³ Pimentel et al., "Water Resources: Agricultural and Environmental Issues," 909.

¹⁴ UN WWAP, "Water in a Changing World, Facts and Figures," 8.

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¹⁶ Glenn et al., "2009 State of the Future, Chapter 1: Global Challenges," 2-2.

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³³ Ibid., 916.

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³⁶ Ibid., 232.

³⁷ Bernauer and Siegfried, "Compliance and Performance in International Water Agreements: The Case of the Naryn/Syr Darya Basin," 479.

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